Conserve and Renew

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, Ca 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov/education

$1.50 per copy; 157 pages, 1990.

Grades 4-6

A collection of energy activities written and organized for use either as a unit on energy or as individual activities to complement existing curricula.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**A-**

DISCIPLINE EMPHASIS

	0 1 2 3 4 5 6
Science	———————
History/Social Science	————————
Health	———————
Mathematics	————————
Performing/Fine Arts	———————
Language Arts	————————
Industrial/Vocational Education	————
Foreign Language	—

COMMENTS

General Content
Curriculum is integrated across all disciplines. Lots of interdisciplinary activities on a wide range of energy issues.

Presentation
Provides a section on ethics. Material is clearly written with the objectives defined.

Pedagogy
The materials encourage problem solving and critical thinking. Needs more hands-on activities that are experiment based rather than game based or listings of energy uses.

Teacher Usability
The materials can be used as a unit or as individual activities to enhance existing curricula. There is little or no background for the teacher and the phrase “it gets tricky” often appears.

Energy Content
Many good lessons which identify renewable/non renewable energy sources. This is an excellent curriculum on energy conservation.

SCHOOL ENERGY MAP

OBJECTIVES: Students will become aware of the energy users at school.

SUMMARY: A map of the school will be made, and the energy users on campus charted and discussed.

GROUPING: 4-6 students.

TIME: 50 min.

SUBJECTS: Math, geography, social studies, science, language arts.

VOCABULARY: Scale, conserve, deferred, utility, budget.

MATERIALS:

- ❑ Energy Users Worksheet
- ❑ *Tape measures*
- ❑ Graph paper

PREPARATION & BACKGROUND: According to the California Energy Extension Service, typical schools spend the bulk of their energy dollars on lighting (28%), heating (25%) and cooling (13%). Other energy uses are; air handling (15%), hot water (5%), and "other" (14%). Students and staff can have a huge impact on these costs. We often use energy without realizing it. We tend to take lights and copy machines for granted. In this exercise, the students will look carefully at the energy users in their school, and learn about how the school's energy budget is spent.

You will need to find out what the utility rates are, and how much the school spends on energy. This information is all in the school utility bills; the administration should be able to provide a copy for you. Use a bill for the same month from last year. Take the total bill (gas + electrical) and the percentages given above, and determine what your school spends on energy in the different categories. (For example: Lighting % x total utility bill = approximate amount spent on lighting for one month; repeat for heating, cooling, etc.)

When students do the mapping, it is instructive to have access to water heaters, space heaters and cafeterias. You could pre-arrange with the custodian to help out, to open doors and accompany students in areas with large machinery. This activity can be expanded to the school district or contracted to individual wings or classrooms. To shorten and simplify the activity, you can make up blank school maps to be filled in. Otherwise it might be instructive to use graph paper, and discuss drawing to scale. Simple sketches of the school will do also. Choose the option best for your class, YOU are the expert in that department!

PROCEDURE:

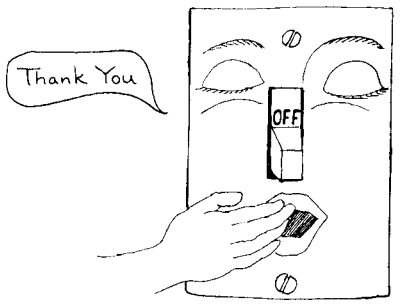
1. Divide students into groups of 4-6. If you have ready-made maps, the smaller group is more appropriate. Tasks can be divided among the students. One student can translate input from others and draw the map, another can record energy users, while two students scan the area and report the things they find that are using energy.
2. Assign a portion of the school to each group. If each group works in the same scale an entire map of the school can be assembled.
3. Students will then tour the school with the worksheet that follows. They are to carefully make note of every energy user they can find, noting where they found each. (e.g. lights, refrigerators, heaters, copy machines, etc.)
4. When the maps are done, have students list all the energy users in their area. Encourage the students to be thorough. Rather than list "lights" have them be specific (e.g. 10 fluorescent lights, and 2 regular, incandescent lights).
5. Have the class reassemble and report on what they found.
6. Next, brainstorm with students how the school might save energy. You can list the ideas on the board as they volunteer thoughts like: close doors to keep heat in or out; turn off the lights next to the windows on bright days; weatherstrip the windows and doors; turn off lights during recess and after school; and reset thermostat to 68/80.
7. Distribute the worksheets and have students fill in what type of energy is being used and propose alternatives where possible. Doing the two previous activities will help students know how to complete the worksheet.

FOR DISCUSSION: 1. Do you think other people in the school realize how much energy they use?

2. Most homes use more energy for heating and cooling; schools typically use more for lighting. Why do you think there is a difference? (Hint: Lots of bodies in a classroom help keep the room warm.)
3. How can individual students help save energy at school? At home?

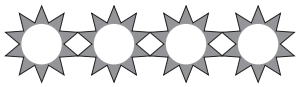
EXTENSIONS: 1. Repeat the exercise, only have students do their own homes this time.

2. Have students write an essay about what they think the money saved should be spent on.
3. Students could prepare a pamphlet on simple ways to save energy at school and distribute it to all classes.
4. Make posters on how to save energy at school and post them around campus.



A Child's Place in the Environment, Unit Six: Achieving a Sustainable Community

California Department of Education
Bureau of Publications, Sales Unit
P.O. Box 271
Sacramento, CA 95812-0271
916-445-1260/1-800-995-4099
916-323-0823 (fax)



Item #1278: $65 per copy (plus tax if in CA), $4.95 shipping; 538 pages, 1996.

Grade 6

A literature based science curriculum designed around four major themes: valuing the environment, systems and interactions, patterns of change, and conservation.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**B**

DISCIPLINE EMPHASIS

	0 1 2 3 4 5 6
Science	———
History/Social Science	———
Health	———
Mathematics	———
Performing/Fine Arts	———
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
Extensive grade-level materials dealing with major ecological principles. Focuses on sustainability. Curriculum is inter-disciplinary with clearly defined objectives.

Presentation
This is a well organized and designed document. It follows a traditional curriculum format.

Pedagogy
Contains curriculum-embedded assessment and utilizes a constructivist approach. Promotes critical thinking skills and problem solving.

Teacher Usability
The Teacher's Preparation section in the front seems particularly useful and sets a stage for the rest of the curriculum. Each lesson has an extensive list of resources which is annotated. The volume of material may be overwhelming —probably best introduced through teacher preparatory workshops.

Energy Content
Curriculum is focused more on human communities than on energy resources.

Lesson 3

What Are Some Components of an Ecosystem?

Story Link: In this lesson students will identify some components of an ecosystem.

Subconcept: Healthy ecosystems are biologically diverse, have complex interrelationships, and are sustainable.

Lesson's Concepts:

- All living things have basic requirements of nutrition, growth, and reproduction, needing food, water, and gas exchange for respiration. (*Science Framework*, page 116)
- Living things live in particular environments which provide them with the resources and the conditions essential for their survival. (*Science Framework*, page 136)
- An ecosystem consists of an environment in which living things interact with each other and with the physical environment. (*Science Framework*, page 137)
- The components of an ecosystem are *(Science Framework*, pages 136–139):
  - An ongoing source of energy—sunlight
  - Living things, including plants, animals, fungi, and microorganisms
  - Nonliving things, such as water, air, and land
  - Soil (in terrestrial ecosystems) (Soil is partly living and partly nonliving.)
  - Natural processes, such as energy flow and cycles (e.g., life cycles, water and carbon cycles)
- Ecosystems can be small or large, terrestrial or aquatic. Examples of terrestrial ecosystems are grasslands, chaparral, forests, and deserts. Examples of aquatic ecosystems are ponds, creeks, estuaries, and oceans.

Overview: Students identify the needs of living things. Each cooperative group designs and prepares a habitat in a two-liter bottle for a specific organism. Students identify some components of an ecosystem on a transparency of a grassland; list the components of the Sierra Nevada ecosystem described in the book, *Sierra*, by Diane Siebert; and categorize the components. Cooperative groups design trioramas of the ecosystem they were assigned in Lesson 2. The class designs a mural of a local ecosystem and prepares a mini-ecosystem, using plastic bottles, which will also be used in Lesson 6.

Time: Two to three hours, plus time throughout several days for students to work on and present their trioramas

Vocabulary: ecosystem, energy source, habitat, organism, soil, sustainable

Curricular Connections: Science, English–Language Arts, Visual and Performing Arts

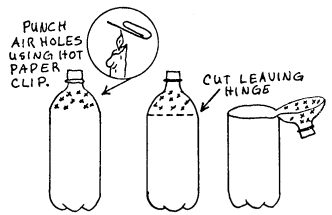
Scientific Thinking Processes: observing, communicating, comparing, categorizing, relating

Preparation

___ **1.** Make a transparency of "A Grassland Ecosystem" (page 84).

___ **2.** Prepare a habitat bottle for each group, using a two-liter plastic bottle.

- Remove the label from each bottle by soaking it in very warm water. A hair dryer can also be used to heat and soften the glue to make the label easier to remove.
- Cut the top, as illustrated. To cut, draw cutting lines around each bottle, make incisions with a knife, and cut with scissors. Leave a section connected to the bottle to act as a hinge.
- Using a jumbo paper clip heated in a candle's flame, poke air holes in the top for ventilation.



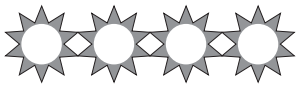
Habitat Bottle

___ **3.** Prepare an ecosystem tube (to be used in Lesson 6), using five two-liter plastic bottles, by cutting and

GRADES 4-6

The Energy Sourcebook——Elementary Unit

TVA Environmental Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)



$35 each; 1992.

Grades 4-6

The “Sourcebook” is intended to aid elementary teachers in teaching basic science and real-life applications of scientific principles in energy studies.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**A-**

DISCIPLINE EMPHASIS

	0 1 2 3 4 5 6
Science	———————
History/Social Science	————
Health	——
Mathematics	———
Performing/Fine Arts	———
Language Arts	————
Industrial/Vocational Education	——
Foreign Language	——

COMMENTS

General Content
A wide variety of activities. The lessons seem to build on previously established concepts. The curriculum is a bit lengthy.

Presentation
The explanations for the teachers are clearly written and the lessons, while teacher directed, are logically framed. The illustrations for concepts, such as how electricity gets from a power plant to a house, are especially well done, as they are simple and clear.

Pedagogy
Each section provides at least one hands-on activity, one activity of researching literature, and one societal/historical activity.

Teacher Usability
Times to complete the lessons vary a great deal which may present scheduling problems. Good background for all lessons—quite thorough.

Energy Content
Good, solid activities in a range of energy areas.

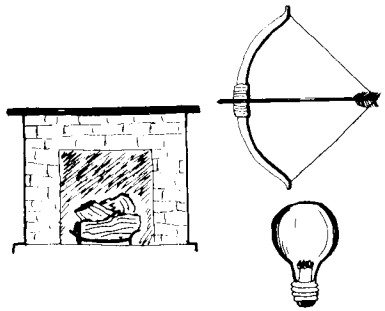
Student

THE INVISIBLE FORCE

1. What is energy? _____

_____

2. Draw a line from the object to the word that tells how energy changes it.

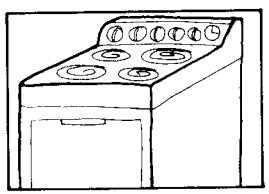


light

movement

heat

3. Label the pictures with the terms potential or kinetic energy.



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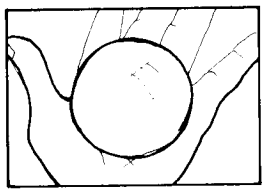
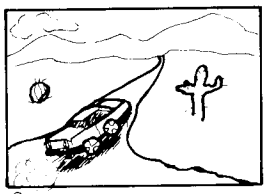


b. _____



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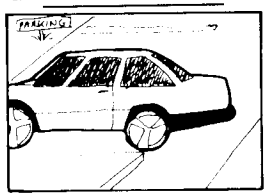

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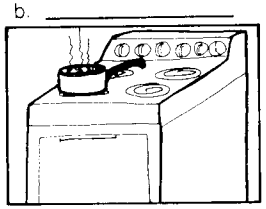

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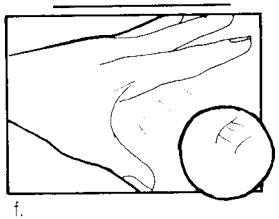


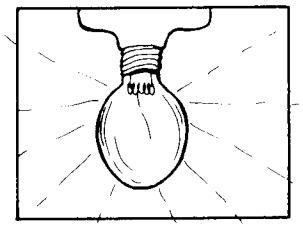
f. _____

Student

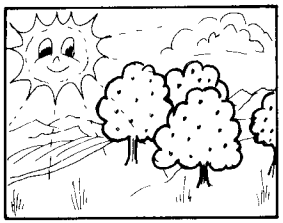
THE INVISIBLE FORCE
(ccntinued)

4. Write the form of energy shown in each picture. Use the following terms:

solar chemical electrical nuclear mechanical



a. _____



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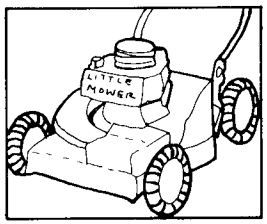

c. _____

d. _____

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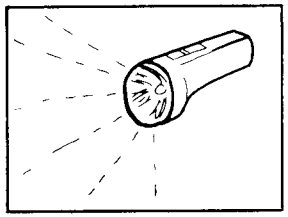

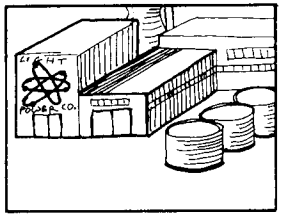

Energizing Your Future With Energy, Economics and the Environment

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National 4-H Supply Service
c/o Cresstar Bank
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Baltimore, MD 21279-0126
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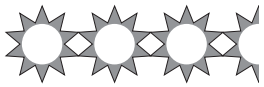
301-961-2937 (fax)



Item #ES1009: $5 per copy. 1996

Grades K-12. Evaluation based on review of materials for grades 4-6.

This guide contains five chapters, each focusing on a different topic related to the interactions among energy, economics, and the environment.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B+**

DISCIPLINE EMPHASIS

	0 1 2 3 4 5 6
Science	———————
History/Social Science	————
Health	—
Mathematics	—————
Performing/Fine Arts	—
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
A very comprehensive curriculum with a variety of lessons emphasizing hands-on and community action activities.

Presentation
Some of the student materials are not clearly described and may be too complex for the suggested grade level.

Pedagogy
Many of the student activity pages look like ordinary worksheets, although on careful examination they present interesting viewpoints.

Teacher Usability
Provides a matrix of activities and appropriate age levels. No table of contents. While this is written for 4-H usage, many of the lessons could be easily used by classroom teachers.

Energy Content
Great material to explore world energy consumption, production, and environmental problems and economics.

Additional Evaluator Thoughts
The material helps students understand that everything costs something and there are tradeoffs in everyday life.

Activity 3.2
Auctioning Energy

Ages: 9 to 18
Style: adult or teen led
Life Skills: disagreeing and refusing, expressing an opinion, observing and listening, asking questions to get information, comparing and selecting alternatives, managing resources to achieve a goal
Pre-Activities: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1
Time Needed: 30 minutes
Group Size: any
Indoors or Outdoors: either
Materials Needed: copies of Activity Sheet 3.2A cut apart; different types of wrapped candies

Activity Goals
To demonstrate how natural resources such as energy are subject to the laws of supply and demand.

Preview
Participants play a game illustrating how supply and demand affect energy prices.

How to Do the Activity
Explain that prices help people decide what to buy, what to make, and what to sell. But how do you think prices are set? (Ask participants to give ideas.)

Prices are influenced by the *law of supply and demand*. As the price of bicycles goes down, more people want to buy them. But as the prices go down, fewer people want to sell them. So the prices may rise because the supply is influenced. As the price of bicycles go up, more people want to make and sell them, but fewer people want to buy them. In the American marketplace, the demand and supply match up fairly closely.

To demonstrate supply and demand, play the following game with the group. Give one participant a handful of candies representing a supply of an energy source (coal, oil, wood, etc.). This person will be the "Energy Auctioneer." In this situation, there is a limited supply of energy (one handful) for the entire group.

Give each person in the rest of the group 10 "dollars" from Activity Sheet 3.2A. Have the Energy Auctioneer ask people to place bids for the handful of candies. Start the bidding with one dollar. Caution participants that they will be bidding on several rounds of candies, so they probably don't want to spend all their money right away. Each round of candies may be different.

Talk about what is happening as the auction continues. Notice that as the price increases, fewer and fewer people bid (i.e., price increases, demand decreases). At some point the price gets so high that most people don't feel it's worth buying the product. Give the handful of candies to the highest bidder.

As a real-life example, note that in the 1970s the supply of oil in the United States (and other countries) was restricted by oil-producing nations. This caused prices to rise. Eventually prices got so high that people began to find ways to use less oil (lower the demand). They purchased more gas-efficient cars and conserved energy in their homes.

In the next round of the game, something new happens. Other people want to make money too, so

they decide to start selling candies. Give four people each a handful of candies different from each other. Now each of these four is an Energy Auctioneer. The supply of energy resources is much larger now.

Start the bidding process again at one dollar. Have all four Energy Auctioneers try to "sell" their energy resources at the same time. What happens? As the supply increases (assuming demand is the same), prices fall.

Ask the group: Suppose only one Energy Auctioneer can sell energy resources. What would happen? (The price would rise. This is called a monopoly. The U.S. government regulates industries to discourage monopolies.) What if another energy source (for example, solar) became available? (It depends on the price of the solar energy--if it is less than the prices of existing sources of energy, people would buy it.) What would happen to the demand for the first energy source? (It would generally go down. However, it might stay stable or even increase, if more industries and businesses were started as a result of lower energy prices.)

Share the following illustration with participants by redrawing it on a chalkboard or flip chart. This will help summarize the basics of energy economics.

Illustration CC

Evaluating Progress
Explain how the laws of supply and demand would affect the price of a favorite product (football, CD, perfume). What would happen to the price if demand increased? (Generally, it would go up.) Decreased? (Generally, it would go down.) What would happen to the price if supply increased? (Generally, it would go down.) Decreased? (Generally, it would go up.)

Fair Game
Research and report on a time in history and how energy sources were affected by supply and demand (e.g., the energy crisis of the 1970s). Show how supply and demand affected energy prices and the effect that had on people's lives.

All for One and One for All
Help residents in your community who have difficulty paying for energy by offering to weather strip their homes or provide other energy saving work. Your local utilities might have similar programs already in place that you can volunteer for. Be sure to evaluate as best you can whether your action saves energy. Ask yourself: if we replace the light bulbs in a den with low wattage ones, will people just use more lamps to do the same jobs? If we help people block drafts at the bottoms of their doors, are we using materials that provide a good return, since it took energy to make the products in the first place? Think about it, and help educate people about using energy and other resources wisely.

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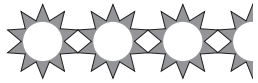


$27.01 (includes tax); 323 pages, 1988.

Grades K-6

This guide provides educators with lessons and instructional techniques that build a fundamental understanding of the environment.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**B-**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	———————
History/Social Science	————————
Health	———
Mathematics	————————
Performing/Fine Arts	———
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
Lessons are not well connected.

Presentation
These materials have a good format for presenting information to both the student and the teacher.

Pedagogy
Great lesson plans involving the students in a variety of hands-on, minds-on activities.

Teacher Usability
The index is arranged in a manner that makes it easy to find lessons supporting existing curriculum.

Energy Content
Only one lesson is given for each energy concept and they are definitely geared to looking at big ideas.

ARE YOU USING ENERGY?

SUMMARY OF ACTIVITY

Students run to see what effects using energy has on their own bodies, search out other ways to determine when energy is being used, and explain in writing how they can tell whether energy is being used.

Time: One 30- to 45-minute period

Setting: Classroom, outdoors

Materials:
- Butcher paper
- Marking pens
- Writing paper

Subjects: Science, physical education, language arts

Key Words: Energy, heat, light, motion

CALIFORNIA FRAMEWORK CONNECTIONS

Science: Physical Sciences, D-2
The ultimate source of most of the energy we use is the sun.

Science: Physical Sciences, D-1
Energy is required when work is done on a system or when matter changes its form.

OBJECTIVE

Based on observations they make about their own bodies after running, students develop and write general statements about how to tell when energy is being used.

BACKGROUND INFORMATION

Solar energy probably is not a direct source of the energy your students use. In this activity students look at the ways they use energy every day, a focus that will continue throughout the remainder of the unit.

There are several things to look for when trying to determine if energy is being used. One way is to check to see if heat is being produced. Almost all common uses of energy give off some heat as a by-product. For example, a light bulb in use becomes hot to touch, a refrigerator motor gives off heat, and a TV or radio gets warm if left on for a while. Many uses of energy also make something move or produce light. A washer spins, a TV lights up, and an alarm clock rings. (Other means of detecting when energy is being used, such as cooling and plant growth, are not covered in this activity.)

PREPARATION AND LEAD-UP

Write the headings "Produces Heat," "Produces Light," "Produces Sound," and "Causes Motion" separately on four pieces of butcher paper.

PROCEDURE

1. Ask, "What work did the sun do in the solar home experiments?" (It heated the air in the house.) Tell students that as part of their study of energy, you want them to use some of their body's energy to run around the track (or another appropriate area). Take the class outside and have them run as fast as they can for about three minutes. Return to the classroom.

2. Ask, "How did you feel after you ran? What changes did you notice in your body?" Most likely students will mention that they got hot. Explain that one of the signs that energy is being used is that heat is produced. Introduce three other methods of determining that energy is being used —motion, production of light, and production of sound. Post the four labeled sheets of butcher paper. Ask, "Which of these happened when you used energy by running? Which apply to the solar home experiments you did?" Have students record each of these uses of energy on the appropriate pieces of butcher paper (for example, running could be listed under "produces heat," "produces sound," and "causes motion").

3. Give students writing paper and have them write complete sentences that begin "I can tell energy is being used when . . . " Volunteers can share their writing.

4. Tell students that they will expand their study of energy by investigating ways they use energy every day (see the home learning suggestion).

DISCUSSION QUESTIONS

Where does your energy come from?
In what other ways besides running do you use energy?
Can you move something without using energy?
Is it possible for you to use absolutely no energy at all? Try it.

EVALUATION

Students' writings from step three can be used to evaluate their understanding.

EXTENSION IDEAS

- Have students demonstrate something that uses energy and explain how they know energy is being used. You may want to allow students to bring props from home or require students to use materials (if needed) from the classroom.
- Have students record how their bodies get energy (foods and beverages) for one day. As a class, trace the direct energy transfers involved from the sun to a student's stomach. (For example, the sun provided energy for corn to grow, the corn provided energy for the chicken to live and grow, and the chicken provided energy for a student to live and grow. These energy transfers can be indicated with arrows: sun → corn → chicken → student.) Have students trace one of the foods they ate from the sun to themselves. Students can write and illustrate a short paper called "The Sun Gives Me Energy."

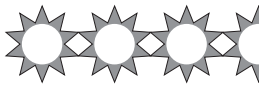
HOME LEARNING SUGGESTION

(Use as lead-up to the next activity)

Before beginning the next activity, students should go on an energy hunt of their homes. Have students list 10 or more ways they and their families use energy at home. Students should also list the sources of energy (such as electricity or natural gas) if possible. Students may wish to ask their parents about energy sources if they are unsure.

Energy, Economics and the Environment——Elementary

Indiana Department of Education
Office of Program Development
Attn: Rose Sloan
Room 229, State House
Indianapolis, Indiana 46204-2798
317-232-9186
317-232-9121 (fax)



$8 per copy; 187 pages, 1994.

Grades 4-6

This curriculum provides a conceptual framework for analyzing energy and environmental issues, and provides teachers with four interdisciplinary teaching units.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B+**
Energy Content	**B**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	
History/Social Science	
Health	
Mathematics	
Performing/Fine Arts	
Language Arts	
Industrial/Vocational Education	
Foreign Language	

COMMENTS

General Content
The lessons seemed to be focused primarily on economic issues.

Presentation
Some of the lessons are interesting and well written, and some are biased.

Pedagogy
Excellent lessons in decision-making through scenarios and personal energy use planning.

Teacher Usability
The length of lessons vary widely and may make scheduling difficult. Background on different types of energy resources is given in teacher information.

Energy Content
Discusses advantages and disadvantages of various energy resources.

Additional Evaluator Thoughts
Some information may be biased or inac-curate, such as page 155 under important concepts to emphasize: “We will never run out of oil or any other nonrenewable resources.”

Activity 5

Further Explorations

Survey ten people in your community to find out:
a. Do you carpool, walk, or ride a bicycle to work or school?
c. Do you use any kind of public transportation to get to work or school?
d. Would you be willing to use these types of transportation? Why or why not?

Research the history of solar energy. How did ancient people use this form of energy? What developments have taken place in the past 100 years? Why isn't it used more today?

Research the term "mass transit system." Where are these systems currently being used? What are the advantages and disadvantages?

Prepare a report on how electricity is generated on wind farms. Describe and draw the different types of wind generators. What are the advantages and disadvantages of these farms? Where are current wind farms located?

Explain how a hydroelectric power plant operates. Label your diagram. Identify some of the environmental concerns about constructing this type of power plant.

Research the location of coal deposits in the United States. What economic impact does coal mining have in different regions of the country, including Indiana. What are the different types of coal? How are they different? Where are they located?

Research the advantages and disadvantages of using wood as a fuel. Investigate how wood was used in the past and how it is used today. Research some of the new trends in wood use, including the new "super trees."

Research which countries of the world rely on nuclear energy. Why do they do so? What do they do with the radioactive waste. How efficient is electricity produced using nuclear power? Have there been any safety problems with this type of energy?

Investigate the cost of electricity in your community. How does it compare with the cost in other communities, states, and regions of the United States? How is electricity use measured?

Research natural gas supplies in your community. How is it transported? Where are natural gas resources located? How is natural gas use measured? What is the cost of natural gas? How does the cost compare with other energy sources?

Activity 6

Let's Talk It Over

Energy efficiency in the United States has improved greatly during the past 25 years. For example, from 1970 to 1993:

* Per capita energy consumption declined from 340 million Btu's to 323 Btu's.
* Energy consumption per dollar of Gross Domestic Product (GDP) declined from 23.12 to 16.73 thousand Btu's.

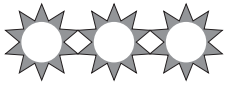
However, because the United States is such a large country and consumes a large amount of energy, some individuals believe that the United States is not doing enough to increase its energy efficiency. Below are some controversial statements for your students to discuss/debate. Help students think critically by applying the concepts learned in this unit.

<u>To increase energy efficiency and help conserve our energy resources:</u>

1. Schools should close during December and January and open in June and July, with no air conditioning allowed.
2. Everyone should be required to keep their thermostats at 68 degrees.
3. All students must take the school bus if they don't walk or ride bicycles.
4. Families should not be allowed to own more than two vehicles.
5. The tax on gasoline should be raised significantly.
6. Large car and van owners should pay an extra "large vehicle tax."
7. The driving age should be raised to 21 so fewer people would be driving cars.
8. Car companies should be required to produce a solar powered car.
9. People should be required to purchase solar powered cars, even if they cost more, have less power, have less passenger and storage space, and are not as safe because of their smaller size.
10. Electric companies should be required to generate some of their electricity using wind or solar power, even if this means higher electric bills for customers.
11. We should let the market price of energy guide the energy decisions of producers and consumers. We should not restrict the freedom of choice in energy matters.

Teach With Energy!

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, Utah 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
e-mail: info@nef1.org
http://www.nef1.org



Item #11TWE4-6: $15 per copy; 143 pages, 1992. Teachers receive a 20% discount upon request. *Teach With Energy*! also available on the web for $15.

Grades 4-6

An energy, electricity, and science resource guide for teachers.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**A-**
Energy Content	**B**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	———————
History/Social Science	————
Health	———
Mathematics	————
Performing/Fine Arts	—————
Language Arts	——————
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
This curriculum seems appropriate for the grade level of understanding.

Presentation
Great graphics—they really help students better understand the written content.

Pedagogy
Few hands-on learning experiences where students explore ideas presented. Contains specific evaluation ideas.

Teacher Usability
Variation in time allotment (30-60 minutes) might pose some scheduling problems. Great background information on renewable/nonrenewable energy sources.

Energy Content
The only page for renewable energy sources doesn't have graphics, is brief on information and not well written.

Additional Evaluator Thoughts
The career awareness notes on several of the lessons is a useful addition.

Solar Collectors

Activity 16

Science, Mathematics, Art, Language Arts	Conversions	Grades	Time
		4-6	3x45 min.

Concept

The efficiency of energy conversion systems differs.

Activity Goal

The students will explain that solar collectors of different colors and absorption mediums will convert solar energy to heat energy at different efficiencies.

What You'll Need

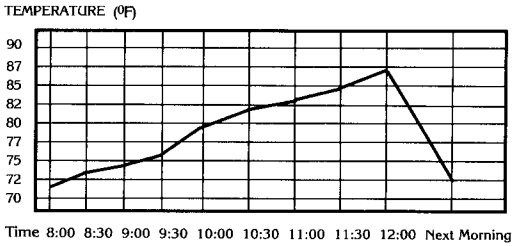
- Various colors of poster paint - flat, not glossy
- At least 8 cans the same size
- Plastic wrap
- Tape
- Dirt, sand, gravel, styrofoam, saltwater to fill cans
- Thermometers

What To Do

1. In small groups have students select a color (black should be one of the colors) from those available and paint a can. The cans should be of the same size.

2. Fill each can half full of cold water and cover with plastic wrap. Use tape to hold plastic wrap in place. Insert a thermometer to measure the temperature of the water. Place cans in the sunlight for several hours. Measure water temperature at 30-minute intervals and the first thing the next morning.

3. Students will then prepare graphs to plot temperature against time, at 30 minute intervals. See sample graph below.



4. Repeat the above using different heat storage mediums: dirt, gravel, sand, saltwater, styrofoam. Use unpainted cans.

5. Discuss with students the results of the investigations. Ask:

A. Which color(s) absorbed the most heat energy? Why?

B. Which storage medium absorbed the most heat energy? Why?

C. Which color and storage medium retained its heat energy the best?

D. Which system is the most efficient?

E. What combination of color and storage medium would you think absorbs and retains the most heat?

F. How might you use what you have learned in the investigations to obtain energy for use in your home?

6. Divide students into groups to research one of the following solar energy technologies and prepare an oral report. They should include drawings, describe how the technology works, its feasibility, how the sun is used and other advantages and disadvantages.

A. Solar ponds

B. Power towers

C. Ocean thermal energy conversion systems

D. Photovoltaics

E. Passive solar technologies

F. Active solar technologies

G. Wind energy

H. Tidal energy

Career Awareness Idea

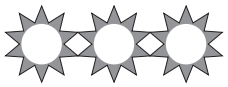
Invite a speaker who works in the area of solar energy to speak to the class about his/her job.

Evaluation Idea

Have the students explain how they would apply what they have learned from the investigations to heat water for their home.

The Universal House

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, CA 95814
916-654-4982
916-654-4420 (fax)
http://www.energy.ca.gov/education



$1.50 per copy; 36 pages, 1992.

Grades 3-6

This guide links energy awareness with resource management and traditional California Indian cultures for students in grades 3-6.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B-**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	———
History/Social Science	———
Health	—
Mathematics	——
Performing/Fine Arts	——
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
This great resource ties together social studies units on Native Americans with science units on energy and architecture.

Presentation
Photos of the different types of Native American structures and innovative methods of insulation relay a visual message.

Pedagogy
Involves students in a variety of hands-on/minds-on activities which encourage critical thinking.

Teacher Usability
The objectives and time frames for each lesson are clearly defined. Could use additional background information on California Indians.

Energy Content
Good lessons on the energy conservation principles of home/dwelling orientation, shading, insulation, and thermal mass.

Additional Evaluator Thoughts
Values the wisdom of native people's simple home building as energy efficient and energy wise.

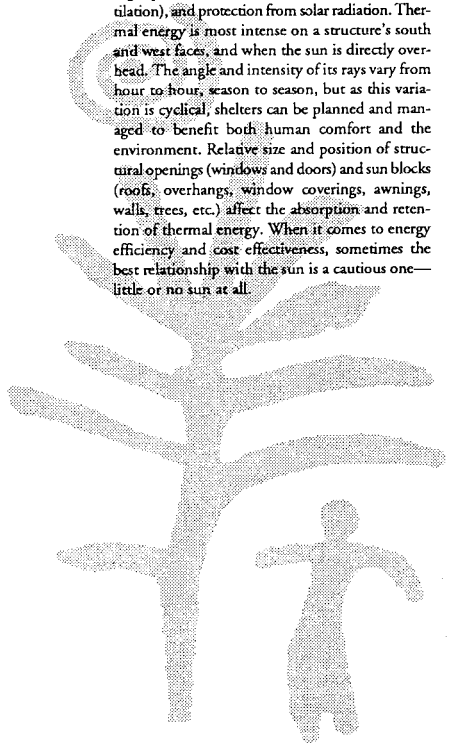
OVERVIEW

SHADE

DEFINITION

shād
Shade results when sunlight, solar energy, is blocked or inhibited.
From the Greek—*Skotis* meaning darkness.

In summer, California Indians not only took advantage of natural shade, they made their own shade with open-air shelters. The sun's energy heats everything in its path, even air. Interrupting or blocking this energy creates shade (diminished light and heat). To cover a space without enclosing it provides shade, circulation of fresh air (ventilation), and protection from solar radiation. Thermal energy is most intense on a structure's south and west faces, and when the sun is directly overhead. The angle and intensity of its rays vary from hour to hour, season to season, but as this variation is cyclical, shelters can be planned and managed to benefit both human comfort and the environment. Relative size and position of structural openings (windows and doors) and sun blocks (roofs, overhangs, window coverings, awnings, walls, trees, etc.) affect the absorption and retention of thermal energy. When it comes to energy efficiency and cost effectiveness, sometimes the best relationship with the sun is a cautious one—little or no sun at all.



SCIENCE FRAMEWORK CONNECTION

Physical Science
E. Energy: Heat
E1. What is heat energy? (page 64)
E2. How do we use heat energy? (page 64)
G. Energy: Light
G1. What is light energy? (page 72)
G2. What are the properties of light? (page 73)

Earth Science
A. Astronomy
A1. How do the objects of the universe relate to one another? (page 79)
B. Geology
B1. What are the responsibilities of humans toward natural resources? (page 97)

Life Science
A. Living Things
A4. How do humans interact with other living things? (page 125)

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ACTIVITY

SHADE

OBJECTIVE
To demonstrate the role that shade plays in the prevention of heat gain.

MATERIALS
Cardboard, scissors or utility knife, ice cubes, ziplock plastic bags, sun.

TIME
50 minutes (near midday).

STUDENTS' PRECONCEPTION
Guide students in visualizing and describing the conditions, cause and effect of a shaded environment in a warm climate. Have them describe the same environment without protection from the sun (especially at midday). Ask the students to predict in which environment (sun or shade) the ice cube will melt more quickly. Why?

PROCEDURE
Cut a rectangle of cardboard measuring 11" x 14", plus 2 squares measuring 6" x 6". Fold the rectangle in half at a 90 (degree) angle to form a cardboard "roof" or sunscreen. Place both squares of cardboard in a sunny location and put an ice cube (in a plastic bag) on each. Immediately place the cardboard roof over one of the ice cubes. Be sure not to shade the other ice cube with your body! After 30 minutes, measure the amount of water that has collected in each bag.

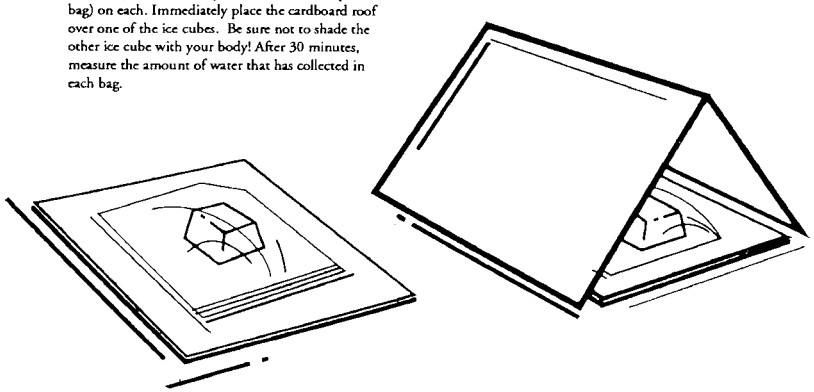
CONCEPTUAL CHALLENGE
Which ice cube melted more quickly—the one in the shade, or the one without protection? Which ice cube absorbed the most thermal energy? Why? What was the source of this energy? What is shade a result of?

APPLICATION
☼ Ask students to illustrate shade with drawings showing a "sunscreen" of their choice blocking the sun and creating shade.

■ Ask students to break into groups and compose lists of as many sources of shade as they can think of that block the sun's heat from their homes, thereby reducing the need for cooling their homes in the summer. Compare lists.

○ Is the moon ever a source of shade? (Diagram a solar eclipse on the blackboard to demonstrate how sunlight is dimmed or eliminated by the moon.)

☼ Discuss where the energy needed to cool a home without sufficient shade comes from.
Can shade be grown? What kinds?



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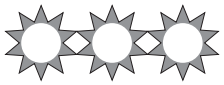
GRADES 4-6

People Power

The Energy Source Education Council
Program Distribution Office
5505 E. Carson Street, Suite 250
Lakewood, CA, 90713-3096
562-420-6814
562-420-1485 (fax)



Class set $65 (Includes a 52 page teacher's guide, video, IBM-compatible computer disk, 35 copies of student materials, and other support materials); 1995.

Grades 5-6

A ten-lesson program that combines classroom instruction with student opportunities for positive, real-life behavior change.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**B**
Energy Content	**B+**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	———————
History/Social Science	————————
Health	———
Mathematics	————
Performing/Fine Arts	————
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	—

COMMENTS

General Content
Personal energy plan is a good way to start the student thinking about a personal commitment to saving energy.

Presentation
This curriculum is presented in a fairly conventional manner, except for the addition of a video and a disk.

Pedagogy
No hands-on, experiential learning activities.

Teacher Usability
Includes teacher background and basic facts at back of booklet. The parent take-home survey is a good way to involve the parents with energy conservation awareness.

Energy Content
A good treatment of future consequences of wasteful use of energy resources through a video and student follow up.

LESSON 9: Home Energy Reports

Materials:

- Completed Home Energy Survey for each student
- IBM or IBM-compatible computer with Windows, if available
- Energy Report Disk
- Home Energy Report for each student (computer-generated or teacher-generated; see procedures in Appendix B on pages 40 and 41)
- Copy of PEOPLE POWER Review Exercise for each student (page 38 in this guide)

Procedures

A. Discuss Home Energy Surveys

- Have students get out their Home Energy Surveys. Ask various questions from the Home Energy Survey (see suggestions below) and have students raise their hands to respond. Record on the chalkboard the number of students giving each response.

  2. Who has a gas heating system at home? Electric? Oil?

  4. Who keeps their thermostat at or below 68° in winter? Above 68°?

  5. Who has central air conditioning? No air conditioning?

  6. Who keeps their thermostat at or above 78° in summer? Below 78°? No thermostat?

  10. Who has more than one refrigerator in their home? One refrigerator?

  17. Who drives their car or cars less than 10,000 miles? Between 10,000 and 20,000? Between 20,000 and 30,000? More than 30,000?

- Discuss findings from the survey items with the students. Use the numbers recorded on the chalkboard to note energy-use patterns in the students' homes. Discuss questions such as "Is the thermostat set below 68° or above 68° in winter in most of your homes? Which setting saves energy?" Etc.

B. Discuss Home Energy Reports

- Hand out or have students get out their Home Energy Reports. Ask them to look over their reports, noting the energy-saving actions that are recommended on it for their family.
- Tell students that you are going to summarize the recommended energy-saving actions for the class. Use the Home Energy Report on page 43 of this guide and read each recommended action listed one at a time. For each action, ask the students to raise their hands if they have that recommended action listed (or checked) on their reports. *(**Note:** The Refrigerator–#5–actually has **two** actions listed—replace an old refrigerator **and** use only one refrigerator. If students have computer-generated reports, these two actions will be shown separately.)* List the action name (e.g., Heater Maintenance) or icon (e.g., Repair Man) on the chalkboard and record the number of students who raise their hands for each recommended action.

  *(**Note:** If students have computer-generated reports, and if their Home Energy Surveys show generally wise energy use, several icons may appear, or appear again, with recommendations not listed on the hand-generated report. Ask students if any of them have "extra" recommendations listed next to the following icons:*
  - *Light Bulb*
  - *Car*
  - *Recycle Symbol*
  - *Refrigerator*
  - *Shower*
  - *Water Heater*
  - *Repair Man*

  Be sure to read these "extra" recommendations.)

- Discuss the summary results with your students. Ask questions such as:
  - — Which energy-saving actions were recommended most often? Why do you think these were the ones?
  - — Which ones do you think would save the most energy or provide the most Eco-Benefits? Why?
  - — Which actions from your list would be easiest for your family to take?
  - — Which actions from your list would be easiest for you to help with? How?
- Tell students to take their Home Energy Reports home to share with their parents.

C. Review the content of the PEOPLE POWER unit

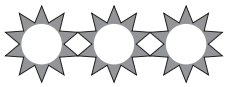
- Inform the students that they will take a test on the PEOPLE POWER unit in the next lesson. Tell them that they are now going to do an exercise reviewing some of the content of the unit. Emphasize that doing well on the review exercise should help them on the test.
- Make a copy of the PEOPLE POWER Review Exercise on page 38 in Appendix A for each student. Have the students complete it on their own.
- Correct the exercise in class using the answer key on page 39.

D. Conduct enrichment activities (optional)

- **Investigate energy costs.** Bring to school recent monthly bills for electricity, natural gas, heating oil, and gasoline. Have students figure the total monthly cost for their family for energy. (You can also have them figure the total cost for the class if you wish.) Try to determine how much money could be saved by cutting down on energy use.
- **Write conservation ads.** Have your students work in small groups to write and illustrate television advertisements that encourage Americans to save energy. Have students act out their ads for the class.
- **Take a field trip.** Arrange for a field trip to an electric power company or, if possible, an electric power plant in your area. Find out what energy source(s) the company uses to supply your electricity. If possible, observe the process of electricity being generated. Ask what actions that the utility takes to help protect the environment, what the actions cost, and who pays the cost.

Let's Get Energized!

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, California 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov/education



$1.50 per copy; 136 pages.

Grades K-6. Evaluation based on review of materials for grades 4-6

A collection of energy education and awareness activities designed for after-school enrichment/childcare programs.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B**
Energy Content	**B**

DISCIPLINE EMPHASIS

	0 1 2 3 4 5 6
Science	———————
History/Social Science	————————
Health	—
Mathematics	————
Performing/Fine Arts	————————
Language Arts	————————
Industrial/Vocational Education	———
Foreign Language	—

COMMENTS

General Content
Interdisciplinary—many language arts, fine arts, and physical (movement) activities that relate to energy concepts.

Presentation
This may be difficult to implement in a classroom. The table of contents is organized in a useful way.

Pedagogy
The challenge labs are especially good activities.

Teacher Usability
Includes a short list of where activities were adapted from. Well organized for use by teachers.

Energy Content
Could use more background on energy resource concepts.

Additional Evaluator Thoughts
Provides energy education activities in an after school format—fun and practical.

Muffin Mining

Objective: Students can describe the advantages and disadvantages of 2 types of coal mining.

Preparation:
1) Buy or make one chocolate chip or raisin muffin (without wrappers) for every student
2) Make a copy of the "Dig It" worksheet (enlarge it if you can)
3) Gather mining materials.

Materials:
1 toothpick/student
scissors or tweezers for each pair or group
a paper plate for each pair or group

Time Frame: 30 minutes
Suggested Audience: grades 2 to 6

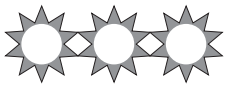
Procedure:
1) Explain to students that they will conduct an experiment to find out how coal is mined and the effects of mining on the environment. The reason for doing this activity is because coal is our most abundant fossil fuel, so it's important to understand what we have to do to use this energy resource.
2) Show students the DIG IT information sheet. Read the facts about coal and then as a group, list those facts which are "Advantages" or "Disadvantages" as shown on the worksheet. (Answers from top to bottom are D,D,A,A,D,A,D.)
3) You will now describe the two types of coal mining using the pictures on the DIG IT sheet. In **strip mining,** large areas of land are scooped up and then sorted through. In **underground mining,** tunnels are dug underground in an area where they think there is a large deposit of coal. Each student is going to have an opportunity to try both methods of mining and decide which they think is the best method.
4) Tell students that no one is to touch their muffin until you have told them to do so. They may eat their muffin *after* the experiment.
5) Pair students up. You may want a younger and older student together. Pass out a muffin to each pair of students (you can use oatmeal raisin for those students who are allergic to chocolate).
6) Have students examine their muffin and estimate how many chips/raisins are in it. Record each group's predictions on the chalkboard. The students will now **strip mine** their muffin. Demonstrate that they do this by taking a section and breaking up until they find every chip/raisin. They are NOT TO EAT ANY OF THEIR COOKIE yet. Record the actual number of chips/raisins found in each muffin on the board. The actual number of chips/raisins should be higher in most cases. Discuss with students the "condition" of their muffin. Equate their muffin crumbs with what the land would look like after strip mining (devastation). Explain that while strip mining is a better method for getting lots of coal, it

damages the land so badly that living things often can not live there.
7) Ask students to set the strip mined muffin crumbs and chips aside. After they've done this give each group a second muffin. (Remind them, not to eat until the experiment is done.) Now the students will do underground mining to get the chocolate chips/raisins out of their muffin. First record the estimated number of chips/raisins. This time students are to carefully remove the chips/raisins **without damaging the muffin.** (KEEP IT IN ONE PIECE.) If the students see a chip/raisin and they can get it without breaking their muffin then they should try to mine it. If a student breaks their muffin they must stop mining because they have done too much damage to the land. Again, record the number of chips found. (There should be a smaller yield.)
8) As students underground mine their muffin for more chips, talk with the group about the advantages and disadvantages of the two mining methods. Which method does each group think is best? Why? (Look back at the advantages and disadvantages for each from DIG IT.)
9) Allow students to eat their muffins.

Adapted from: IDEAS, Iowa State Dept. of Education, 1987

Science Alive! Unit 1 Energy Flow

Science Oriented Learning
1324 Derby Street
Berkeley, CA 94702
510-644-2054
510-642-1055 (fax)



$25 per volume, $115 per set, plus 10% shipping and handling, plus tax; 183 pages, 1988.

Grades 4-6

Designed with the busy teacher in mind, the program requires no scientific background, little preparation time and few, inexpensive materials, and offers a simple, effective approach which makes science easy and fun to teach.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**C+**
Energy Content	**B-**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	———
History/Social Science	———
Health	——
Mathematics	———
Performing/Fine Arts	——
Language Arts	———
Industrial/Vocational Education	—
Foreign Language	———

COMMENTS

General Content
Multicultural, historical, and inter-approach.

Presentation
Good variety of lessons all of which have Spanish-translated student pages.

Pedagogy
This curriculum uses a systems approach throughout the unit. There are many traditional dittos whose formats are not challenging.

Teacher Usability
All student lab sheets are available in Spanish.

Energy Content
Describes the energy present in plants, animals, and food, and explores how humans use energy in a basic, introductory fashion.

Additional Evaluator Thoughts
There is an energy and exuberance about this curriculum which is quite energizing. It feels like it was created with the idea of making learning enjoyable.

SINKING SHIP

DESCRIPTION: Students must work together to choose five or ten given items, that will enable them to survive in a different cultural community.

GOAL: To highlight the importance cooperation and communication in community problem solving.

TRANSITION:

Sinking ship asks students to become cultural ambassadors throughout the world.

BACKGROUND: Cooperative problem solving is the name of the game here. In six different versions, students role play the crew salvaging the most important items on board before their ship goes down. Each version offers a comparison and contrast between long-term and short-term community planning (i.e. a gun with six bullets vs. a pair of rabbits) as well as between different cultures (i.e. Anglo, Mexican, Chinese, Indian, African, and Native American). After playing one version and learning the activity structure, subsequent versions can be played in one half the time.

To add excitement and realism to the game bring "survival" items (i.e., dictionaries, jugs of water, Atari video) to the classroom. This would serve the younger grades (1-3) well for it adds a concrete element to an abstract role play.

ACTION:

1. Divide students into groups of six.
2. Read the following script.

   On a field trip, you and three friends went on a boat to see some islands in the ocean. Your boat is now near a large island. We know that there are no people on it. We do not know if there are animals on this island or if there is water on the island. From your boat you can see that there are some trees and greenery on the island. SUDDENLY, the boat scrapes a large rock. It tears a hole in the bottom of the boat! The boat will sink in 30 minutes. Fortunately, there is a small lifeboat. You can use this lifeboat to reach the shore of the island but it is not big enough to sail all the way back home. Your lifeboat can hold your crew and 5 things that your group chooses to take from the larger boat. Remember you have just 30 minutes to survive . . .

   En una gira de investigación tú y tres amigos se fueron en un barco a ver unas islas. (Escoge tres amigos para leer el resto de este cuento). Tu barco navegó hasta llegar cerca de una isla grande. Sabemos que esta desierta, no hay ninguna gente en ella. No sabemos si hay animales, o si hay agua en la isla. Desde el barco puedes ver que hay algunos árboles y alguna vegetación. De repente, el barco se raspa contra una gran roca y se hace un hoyo en el fondo. El barco se va a hundir en treinta minutos. Afortunadamente, hay un pequeño bote de salvamento. Puedes usar este bote de salvamento para alcanzar la orilla de la playa, pero no es lo suficientemente grande para navegar hasta regresar a casa. Tu bote de salvavidas solamente tiene espacio para ustedes cuatro, y para cinco cosas que tu grupo escoja llevarse del barco. Recuerda que nada más tienes treinta minutos para salvarte. ¿Cuales cinco cosas escojerá tú grupo? Deben de cooperar y tomar una decisión juntos.

SINKING SHIP
Renewable VS. Non-Renewable

Help! The ship is going to sink. We must rescue supplies in order to survive. Your lifeboat can hold crew and five things your group chooses to take from the Sinking Ship. Remember, you have just thirty minutes left.

1. 5 cans of Sterno
2. One Solar Oven
3. One six-pack of Coca Cola
4. One four foot square piece of plastic
5. 50 pounds of hamburger
6. One pair of chickens
7. One fishing rod and reel
8. One loaded gun
9. One Mercedes Benz
10. One burro

List the five (5) things your group chose, then explain why you chose them:

	WHAT	WHY
1.		
2.		
3.		
4.		
5.